

CLAIMS

What is claimed is:

- 1 1. A resin composition comprising:
2 a film-forming polyester; and
3 an effective amount of oxygen-scavenging particles comprising at least one
4 oxygen-scavenging element; wherein the particles have a particle size distribution
5 such that particles of less than about 25 microns in size do not exceed a
6 concentration defined by the formula
7
$$\text{ppm} = 512.3 \times d$$

8 wherein ppm is the approximate concentration of particles of less than about 25
9 microns in size in parts per million by weight, and d is the apparent density of the
10 particles of less than about 25 microns in size in grams per cubic centimeter.
- 1 2. The resin composition of claim 1, wherein said polyester comprises linear
2 polyesters or branched polyesters.
- 1 3. The resin composition of claim 1, wherein said polyester comprises
2 polyethylene terephthalate, copolymers of polyethylene terephthalate, polyethylene
3 naphthalate, copolymers of polyethylene naphthalate, polybutylene terephthalate,
4 copolymers of polybutylene terephthalate, polytrimethylene terephthalate, or
5 copolymers of polytrimethylene terephthalate.
- 1 4. The resin composition of claim 1, wherein said oxygen-scavenging element
2 comprises calcium, magnesium, scandium, titanium, vanadium, chromium,
3 manganese, iron, cobalt, nickel, copper, silver, zinc, tin, aluminum, antimony,
4 germanium, silicon, lead, cadmium, rhodium, or combinations thereof.
- 1 5. The resin composition of claim 1, wherein said oxygen-scavenging element
2 comprises iron.

1 6. The resin composition of claim 1, wherein said effective amount of oxygen-
2 scavenging particles is from about 50 to about 2500 parts per million by weight of
3 the resin.

1 7. The resin composition of claim 1, wherein said oxygen-scavenging particles
2 have a particle size range of about 20 to about 70 microns.

1 8. The resin composition of claim 1, wherein said particles of less than about 25
2 microns in size have an apparent density of about 2.44 grams per cubic centimeter.

1 9. The resin composition of claim 1, wherein particles of less than about 20
2 microns in size have an apparent density of about 2.44 grams per cubic centimeter,
3 and do not exceed a concentration of about 800 parts per million by weight of the
4 resin.

1 10. The resin composition of claim 1, wherein said oxygen-scavenging particles
2 are pre-treated with one or more reaction-enhancing agents.

1 11. The resin composition of claim 1, wherein bottles produced from said resin
2 have a Hunter haze value of about 10 % or less.

1 12. A resin composition comprising:
2 a film-forming polyester; and
3 an effective amount of oxygen-scavenging iron particles, wherein the iron
4 particles have a particle size distribution such that particles of less than about 25
5 microns in size do not exceed about 1250 parts per million by weight of the resin.

1 13. The resin composition of claim 12, wherein said polyester comprises linear
2 polyesters or branched polyesters.

1 14. The resin composition of claim 12, wherein said polyester comprises
2 polyethylene terephthalate, copolymers of polyethylene terephthalate, polyethylene

3 naphthalate, copolymers of polyethylene naphthalate, polybutylene terephthalate,
4 copolymers of polybutylene terephthalate, polytrimethylene terephthalate, or
5 copolymers of polytrimethylene terephthalate.

1 15. The resin composition of claim 12, wherein said effective amount of iron
2 particles is from about 50 to about 2500 parts per million by weight of the resin.

1 16. The resin composition of claim 12, wherein said iron particles have a particle
2 size range of about 20 to about 70 microns.

1 17. The resin composition of claim 12, wherein particles of less than about 20
2 microns in size do not exceed about 800 parts per million by weight of the resin.

1 18. The resin composition of claim 12, wherein said oxygen-scavenging particles
2 are pre-treated with one or more reaction-enhancing agents.

1 19. The resin composition of claim 12, wherein bottles produced from said resin
2 have a Hunter haze value of about 10 % or less.

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1 20. A resin composition comprising a film-forming polyester and from about 50
2 to about 2500 parts by weight of iron particles per million parts by weight of the
3 resin, wherein the concentration of iron particles of less than about 25 microns in
4 size does not exceed about 1250 parts per million by weight of the resin.

1 21. The resin composition of claim 20, wherein said polyester comprises linear
2 polyesters or branched polyesters.

1 22. The resin composition of claim 20, wherein said polyester comprises
2 polyethylene terephthalate, copolymers of polyethylene terephthalate, polyethylene
3 naphthalate, copolymers of polyethylene naphthalate, polybutylene terephthalate,
4 copolymers of polybutylene terephthalate, polytrimethylene terephthalate, or
5 copolymers of polytrimethylene terephthalate.

1 23. The resin composition of claim 20, wherein said iron particles have a particle
2 size range of from about 20 to about 70 microns.

1 24. The resin composition of claim 20, wherein particles of less than about 20
2 microns in size do not exceed about 500 parts per million by weight of the resin.

1 25. The resin composition of claim 20, wherein said oxygen-scavenging particles
2 are pre-treated with one or more reaction-enhancing agents.

1 26. The resin composition of claim 20, wherein bottles produced from said resin
2 have a Hunter haze value of about 10 % or less.

1 27. A polyester resin composition for use in forming transparent articles having
2 low haze, the resin composition comprising from about 50 to about 2500 parts by
3 weight of iron particles per million by weight of the resin, wherein said transparent
4 articles have a Hunter haze value of about 10 % or less.

1 28. The resin composition of claim 27, wherein said polyester comprises
2 polyethylene terephthalate, copolymers of polyethylene terephthalate, polyethylene
3 naphthalate, copolymers of polyethylene naphthalate, polybutylene terephthalate,
4 copolymers of polybutylene terephthalate, polytrimethylene terephthalate, or
5 copolymers of polytrimethylene terephthalate.

1 29. The resin composition of claim 27, wherein said iron particles have a particle
2 size distribution such that particles of less than about 25 microns in size do not
3 exceed a concentration defined by the formula

4
$$\text{ppm} = 512.3 \times d$$

5 wherein ppm is the approximate concentration of particles of less than about 25
6 microns in size in parts per million by weight, and d is the apparent density of the
7 particles of less than about 25 microns in size in grams per cubic centimeter.

1 30. An article formed from a resin composition comprising an effective amount
2 of oxygen-scavenging particles, wherein the Hunter haze value of the article is
3 about 10 % or less.

1 31. The article of claim 30, wherein said article is a bottle.

1 32. The article of claim 30, wherein said resin composition comprises
2 polyethylene terephthalate, copolymers of polyethylene terephthalate, polyethylene
3 naphthalate, copolymers of polyethylene naphthalate, polybutylene terephthalate,
4 copolymers of polybutylene terephthalate, polytrimethylene terephthalate, or
5 copolymers of polytrimethylene terephthalate.

1 33. The article of claim 30, wherein said Hunter haze value of said article is about
2 8 % or less.

1 34. A method for incorporating high levels of oxygen-scavenging particles into a
2 film-forming polyester resin composition with low haze comprising the steps of:
3 providing an effective amount of oxygen-scavenging particles comprising
4 at least one oxygen-scavenging element, wherein the particles have a particle size
5 distribution such that particles of less than about 25 microns in size do not exceed
6 a concentration defined by the formula

$$7 \quad \text{ppm} = 512.3 \times d$$

8 wherein ppm is the approximate concentration of particles of less than about 25
9 microns in size in parts per million by weight, and d is the apparent density of the
10 particles of less than about 25 microns in size in grams per cubic centimeter;

11 adding said oxygen-scavenging particles to a polyester resin composition
12 during one or more of the process steps of
13 melt phase polymerization of the polyester;
14 post polymerization and prior to pelletization;
15 solid state polymerization of the polyester; and
16 extrusion.

1 35. The method of claim 34, wherein said step of adding oxygen-scavenging
2 particles to a polyester resin composition produces a masterbatch of oxygen-
3 scavenging resin; and wherein said method further comprises the step of adding
4 said masterbatch to additional resin.

1 36. The method of claim 34, wherein said polyester resin comprises polyethylene
2 terephthalate, copolymers of polyethylene terephthalate, polyethylene naphthalate,
3 copolymers of polyethylene naphthalate, polybutylene terephthalate, copolymers
4 of polybutylene terephthalate, polytrimethylene terephthalate, or copolymers of
5 polytrimethylene terephthalate.

1 37. The method of claim 34, wherein said oxygen-scavenging particles comprise
2 oxidizable forms of calcium, magnesium, scandium, titanium, vanadium,
3 chromium, manganese, iron, cobalt, nickel, copper, silver, zinc, tin, aluminum,
4 antimony, germanium, silicon, lead, cadmium, rhodium, or combinations thereof.

1 38. The method of claim 34, wherein said oxygen-scavenging element comprises
2 iron.

1 39. The method of claim 34, wherein said effective amount of oxygen-scavenging
2 particles is from about 50 to about 2500 parts per million by weight of the resin.

1 40. The method of claim 34, wherein said particles of less than about 25 microns
2 in size have an apparent density of about 2.44 grams per cubic centimeter.

1 41. The method of claim 34, wherein particles of less than about 20 microns in
2 size have an apparent density of about 2.44 grams per cubic centimeter, and do not
3 exceed a concentration of about 800 parts per million by weight of the resin.

1 42. The method of claim 34, wherein said oxygen-scavenging particles are pre-
2 treated with one or more reaction-enhancing agents.

1 44. The method of claim 34, wherein bottles produced from said resin have a
2 Hunter haze value of about 10 % or less.

1 45. A resin composition comprising:
2 a film-forming polyester; and
3 particulates; wherein the particulates have a particle size distribution such
4 that particles of less than about 25 microns in size do not exceed a concentration
5 defined by the formula

$$\text{ppm} = 512.3 \times d$$

6
7 wherein ppm is the approximate concentration of particles of less than about 25
8 microns in size in parts per million by weight, and d is the apparent density of the
9 particles of less than about 25 microns in size in grams per cubic centimeter.